THE INNOVATION CATALYST

March 2023

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TECH TRANSFER TIP

with Administrative Specialist Staci Steward:

Many new technologies reported at Goddard are software-based. Your software could have applications in American industry, academia, and other government agencies. Software release is a critical component of technology transfer. Remember to submit your NTR.

UPCOMING EVENTS:

INNOVATOR HOUR

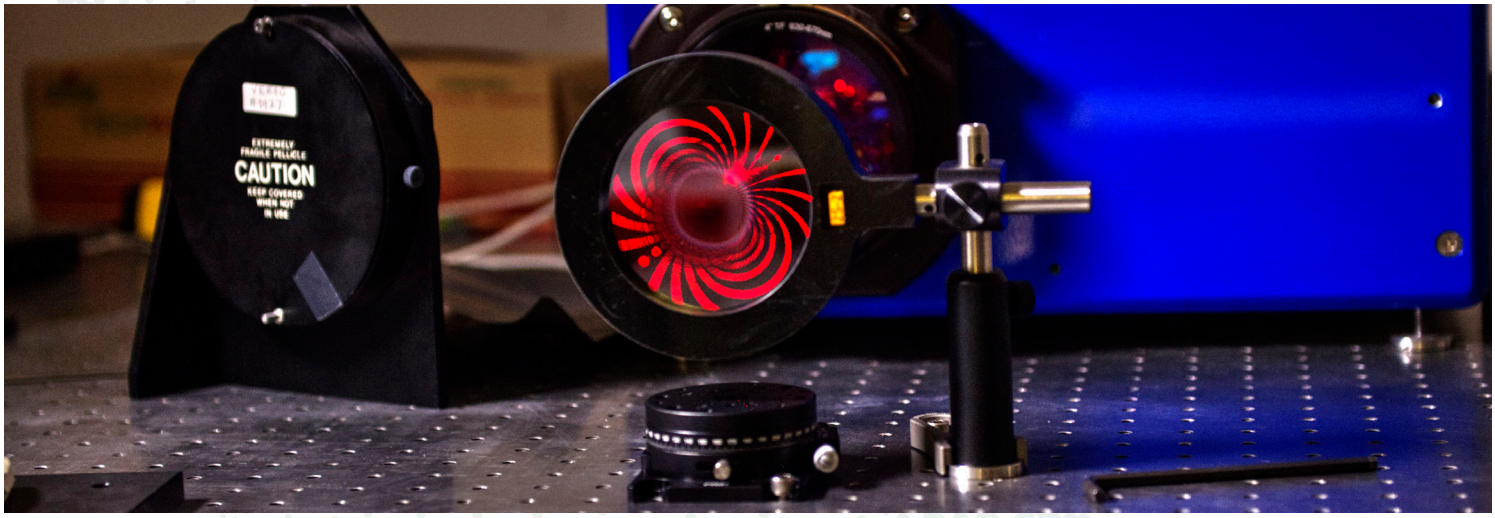
TUESDAY, MARCH 14, 2023

1:00–2:00 P.M.

STRATEGIC PARTNERSHIPS OFFICE

NP-2023-2-024-GSFC

Inventors of the Month



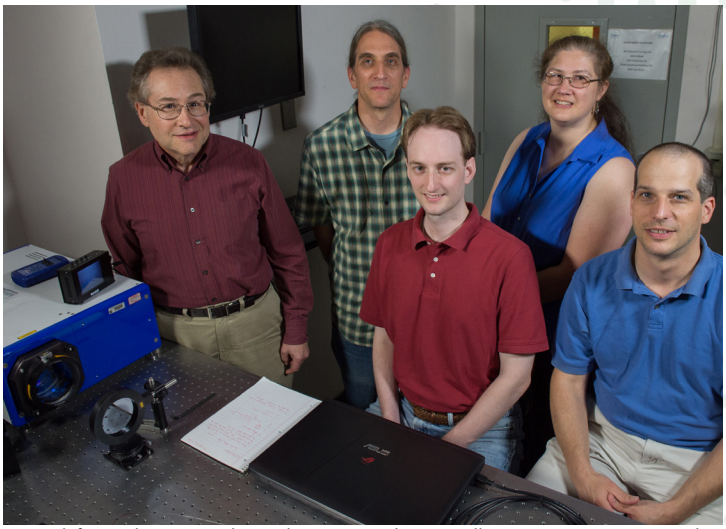
This image shows how the photon sieve brings red laser light to a pinpoint focus on its optical axis. Photo Credit: NASA/W. Hrybyk

All the Better to See You With

Since the beginning of 2023, the Earth has been hit with powerful bursts of solar energy, phenomena known as solar flares, multiple times. After being struck by a solar flare on New Year's Day, the Earth was a target of several other eruptions. Most recently on February 17, NASA's Solar Dynamics Observatory detected a powerful solar flare, prompting the U.S. Space Weather Prediction Group to put out a geomagnetic storm alert. The intense solar flare lasted one hour and 12 minutes, causing temporary radio blackouts on the sunlit side of Earth.

Since their discovery more than 160 years ago by English amateur astronomers Richard Christopher Carrington and Richard Hodgson, solar flares have been associated with sunspots on parts of the Sun with strong magnetic fields, called active regions. A solar flare occurs when magnetic energy on the Sun has built up in the solar atmosphere and then is suddenly released. Solar flares and eruptions can impact radio communications, electric power grids, and navigation signals. They also pose risks to spacecraft and astronauts in space.

Predicting solar flares is a very challenging task. Typically, a person cannot see a solar flare by simply staring up at the Sun. Flares are in fact difficult to see because the Sun is already so bright. Astronomers must use specialized scientific instruments to detect the light emitted during a flare. Radio and optical emissions from flares can be observed with telescopes on Earth. However, other energetic emissions from the Sun during a flare, including X-rays and gamma rays, require telescopes in space. The reason is that electromagnetic radiation in these frequencies cannot penetrate Earth's atmosphere.



From left to right, Doug Rabin, Adrian Daw, John O'Neill, Anne-Marie Novo-Gradac, and Kevin Denis are developing an unconventional optic that could give scientists the resolution they need to see finer details of the physics powering the sun's corona. Photo Credit: NASA/W. Hrybyk

To gain the right magnification and resolution needed to see the Sun and detect a potential solar flare would require NASA to build a large, complex, and costly telescope – comparable to the James Webb Space Telescope – and then launch it into low Earth orbit (LEO). Presently, a team of Goddard scientists and engineers – Adrian Daw, Dr. Doug Rabin, Kevin Denis, Meng-Ping Chang, and Jake Parker – in the Heliophysics Science Division are working on an alternative approach. Called a photon sieve, this revolutionary telescopic optic or lens would give scientists the resolution they need to see the finer details of the Sun and potentially even give advanced warning of solar activity.

Most telescopes focus light through refraction or reflection mirrors. The photon sieve is a variant of the Fresnel zone plate, which is a diffractive optic that can have very high optical resolution. These plates often cause light to diffract as light travels through a thin opening and then spreads out. However, unlike the Fresnel plate, the photon sieve consists instead of a set of tightly spaced rings, alternatingly transparent or opaque. When light travels through the spaces between the precisely arranged opaque zones, the diffracted light converges on a specific point to create a high-resolution image that can be recorded on film.

"What the photon sieve will allow us to do is see and understand the events on the Sun [including solar flares]. We are going to be able to see in more detail than ever before what is happening on the Sun," said Daw, a research assistant and solar physicist. "The beauty of the photon sieve is that it will provide better resolution."

The Goddard team has already fabricated three sieves made from three different materials. Before the end of the calendar year, they plan to begin testing them to see if they can operate in space. They will explore how well they can survive an intense space launch as well as the extreme environment in space.

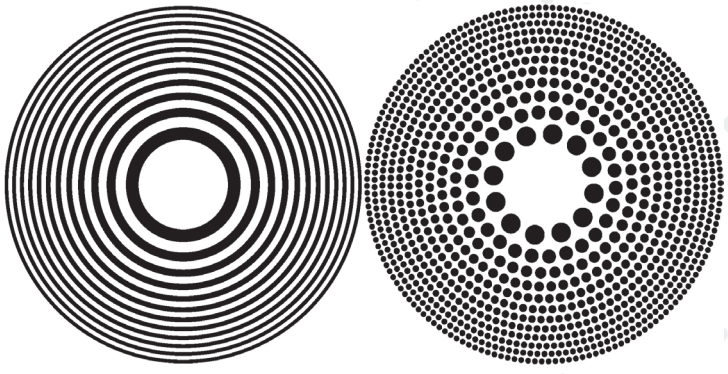
Current plans call for including the photon sieve on the Virtual Super-Resolution Optics Using Reconfigurable Swarms (VISORS) mission, a SmallSat project. Comprised of two 6U CubeSats and due to launch in 2024, the National Science Foundation-funded VISORS is a collaboration of 11 universities and NASA, designed to capture high-resolution images of the active regions of the corona of the Sun.

As currently designed, one CubeSat will contain the photon sieve, while the other will contain the detector or film. The arrangement will enable the extremely long focal length (or distance from the lens to the film) needed to capture high-resolution images in the extreme ultraviolet wavelengths of the Sun. To properly take images, the two spacecrafts must be perfectly aligned in space.

"With VISORS, we are providing and designing the science instruments, and then all these universities are working with us on the spacecraft infrastructure to actually be able to maintain the formation," explained Daw. "It is very hard to maintain the precision required. What that means is while you are taking the exposure [or picture], you don't want these two spacecrafts to move with respect to each other by 10 microns (or 10 micrometers) and that is not easy to achieve. The whole orbit [of the two CubeSats] is designed so that things line up perfectly when you turn the propulsion off [to be able to take the pictures]."

The design team is now testing the photon sieve in Goddard's laboratory. They hope to test it in a space launch before the end of the calendar year. The pictures or raw images taken by VISORS will be sent from the spacecrafts to a ground station system at Georgia Tech. Researchers at several participating universities will then analyze the data and produce a report, which will be presented to the entire science community. Daw notes that the data will likely generate attention from researchers interested in the Sun, as well as those studying the performance of optics.

"VISORS is going to be the first demonstration of the [photon sieve] concept in space and that will be followed up in the future with a larger mission looking at more wavelengths with better light collecting power, higher resolution, etc.," said Daw. "This is a really neat project to work on because it is going to push the edge on our advancement of solar and optical sciences. So, I am really excited to see VISORS come together and pave the way for the next mission."



This drawing shows the differences between Fresnel zone plates (left) and the photon sieve (right). The photon sieve, which is dotted, has millions of precisely machined holes. Photo Credit: NASA

Acting Center Director Mitchell Outlines His Vision and Priorities for Goddard in 2023

Acting Center Director David Mitchell, Photo Credit: NASA/GSFC

At the Goddard Town Hall on January 31, Acting Center Director David Mitchell introduced himself, discussed near- and long-term goals of the center, and answered questions directly from employees in attendance. Along with other members of Goddard's senior leadership, he addressed a wide range of issues, including procurement, management operations, information technology, finance and budgetary concerns, and human resources.

Mitchell, who returns to Goddard after serving as NASA's chief program management officer, began by saying, "It is a privilege to be here in front of you [in] this particular position [as acting center director]." He framed the purpose of the Town Hall by adding, "I know there are a lot of questions about the future [of Goddard] and what is happening at the center, the work environment, and the work activity – [in terms of] what is coming down the pike and what is going on currently. So, I am really excited to take your questions."

He introduced himself to those in attendance by describing himself as an "old guy, who has been around [Goddard] since 1987," when he worked on transportation systems for instruments and spacecraft, including NASA's Cosmic Background Explorer. That satellite, also known as Explorer 66, was used from 1989 to 1993 to study the origin, structure, and evolution of the universe. More recently, from 2015 to 2021, Mitchell was director of Goddard's Flight Projects Directorate, where he supervised over 80 missions, ranging from SmallSats to NASA flagship projects such as the James Webb Space Telescope. "Coming back to Goddard," said Mitchell, "is like being back home with the family again."

Mitchell laid out three priorities as Goddard moves forward in 2023. Those include 1) meeting agency commitments to deliver technologies, products, and software on time, 2) learning to work across all the NASA centers and facilities, and 3) transitioning to working in a post-pandemic environment.

"It is so important how we meet our commitments," explained Mitchell. "The reason why I was brought [to headquarters as chief program management officer] last January [was because] there was concern about how [Goddard] was not meeting our commitments. And quite frankly, it was a disappointment to our external stakeholders. How we are going to meet our commitments going forward is important, but [we have to ask ourselves]: What else should we be doing?"

To accomplish his goal, Mitchell shared his vision of the work environment he hopes to create and future efforts Goddard will undertake in the coming months. The three areas he laid out were, first, to "empower leaders" and workforce personnel to solve internal problems. Second, in a post-pandemic world, employees need to do a better job of connecting and reconnecting with their virtual counterparts at Goddard . Third, they need to create more open communication when working with people across the center.

"What I mean about empowering leaders and the workforce is not [saying] we need more money, but [rather] let's figure out what we can do to solve this problem," explained Mitchell. "I want people to know they are empowered to do this. One of the things that I am concerned about is what we are doing for the next generation workforce that is coming in at Goddard. Many of us in our formative years benefited greatly from learning from our mentors and community around them. And part of that is getting out of your office

Town Hall panel, Photo Credit: NASA/GSFC

to start connecting with people outside of your [immediate] organization. These are some of the problems encountered by people working in a remote [environment], where you come into work and there is nobody [physically] around you, just Zoom meetings."

Turning his attention to the future of Goddard's work environment, Mitchell stated that senior management is going to, "think creatively on how we can use our workspace together by building on what has been successful for NASA and Goddard as that relates to culture." He went on to elucidate, "That means embracing diversity, civility, collaboration, teamwork, and flexibility. [Flexibility] is an important word that is going to resonate with a lot of people. There are benefits to both [on-site and off-site work], and we are going to address this in a way that works for the organization, the mission, and the workforce."

On the subject of work in a post-pandemic environment, employees had several questions about potentially losing their [dedicated] Goddard workspace if they only work on campus a few days of the week. "I can tell you at the agency level, we have had three meetings since the beginning of the year about the future of work," said Goddard Deputy Director of Human Resources Omar Williams. "There is not going to be any agency policy about how many days somebody needs to be in the office to get an office. Instead, we are thinking of ways to craft a new normal for the agency."

"One of the fundamental changes that is coming within the agency is the prescriptive direction for the centers – this is what you will do and not do in this new work environment," added Goddard Associate Center Director Ray Rubilotta, "The shift [is] to now allow center directors like Dave [Mitchell] the ability to tailor things for the culture of their centers. Everybody needs to be patient and assume positive intent and we are going to work through this together as we always have as a community, to come up with the best results for both the mission and people who are supporting that mission. The future of work [at NASA] is going to evolve for years to come."

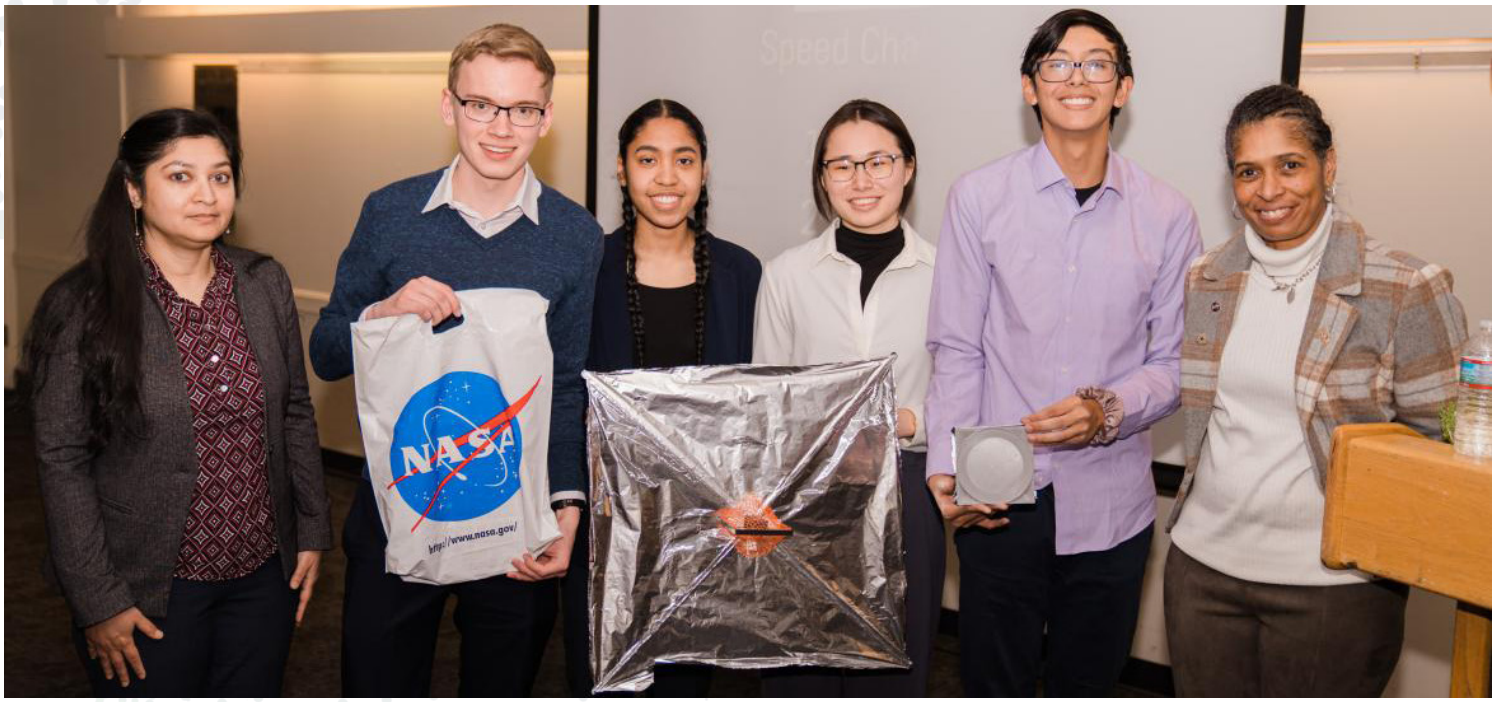
Addressing that from the prospective of workforce personnel, Nipa Shah, Goddard's deputy director of Acquisitions said, "The mission of NASA falls on all of our shoulders. I think the contractor community and the civil servant community are well aligned."

Other questions raised covered the monetary cost of working remotely, funding sources for mentoring new workforce personnel, and replacement schedules for computer and IT equipment. Topics also included water quality, eliminating rodents, building maintenance updates, delays in badging in new personnel, and the timeline for repairing the bridge to Goddard over the Baltimore-Washington Parkway. "The repair of the parkway bridge is in the FY23 budget and right now is [in the] design [phase]," said Marilyn Tolliver, deputy director of Management Operations. "Sometime around July we will make the award of the contract and our best guess is that construction will start in the fall, and it will be anywhere from 18 to 24 months for construction to be complete."

One of the other topics of great interest that came up during the Q&A session included how the new Congress will affect the overall NASA budget. Chief Financial Officer Sherri Corbo commented that NASA has been through this before. While she noted there will likely be some financial impact to existing Goddard programs, Corbo urged employees not to get too concerned about it at this time.

"There are a lot of comments House [of Representatives] Speaker [Kevin] McCarthy has made in terms of the federal budget," said Corbo. "They want to reduce the debt ceiling and return to FY21 spending levels. There is always talk about a CR [Continuing Resolution to keep federal programs, agencies, and departments running at current spending levels] and potential [federal government] shutdown due to the lack of CR. When Administrator [Bill] Nelson was here [at the Town Hall] in January, he said we [NASA] are looking at a 12% [budget] reduction [from FY22]. I would just advise everyone to be patient and see what happens when Congress gets [the President's] budget this summer."

"Yes, the agency and the government are under some duress with the budget," Mitchell acknowledged. "If there is one advocate who can help us, I believe it is Administrator Nelson, so we have to be optimistic [there will not be severe cuts to the NASA budget]. We have a path to forge together and a new way of operating [in the post-pandemic environment]. But it is so cool to work at this place and it is so awesome to work with all of you."



One of the winning MOMENTUM 2023 teams poses with NASA Goddard's Dr. Mahmooda Sultana(far left), Project Lead, and Dr. Aprille Ericsson(far right). Photo Credit: MIT Office of Minority Education

MIT Students Rise to the "Challenge" of NASA

Forty first- and second-year undergraduate students from the Massachusetts Institute of Technology (MIT) discovered what it is like to be an engineer or scientist working at NASA Goddard by solving real-life engineering problems presented to them by scientists and engineers working at the agency. Goddard was invited by MIT to put together a curriculum, training program, and engineering challenge for MOMENTUM Challenge 2023, which is designed to prepare students for a future in the field of science and engineering.

The MOMENTUM Challenge is an annual MIT interdisciplinary design course offered to undergraduate students, to give them hands-on technical experience. For the first time in the program's history, Goddard was selected to lead the Challenge. In past years, General Motors and Capital One were afforded this opportunity.

"The Challenge with MIT seemed like a good opportunity to inspire the next generation [of engineers] to pursue space missions, and perhaps, consider coming to NASA [to work] in the future," said Dr. Mahmooda Sultana, an instrument scientist at Goddard's Planetary Environments Laboratory and principal investigator of the Goddard-themed course. "The goal was to get the students involved in some real problems from one of the NASA missions and teach them how to think about problem solving with basic math and engineering without being intimidated."

Sultana noted that MOMENTUM 2023 not only received a record number of student applications to participate, but also was full within two days of announcing the Challenge. The course is limited to 40 students. Goddard's participation was only made possible through SPO's support in executing a Space Act Agreement between the two organizations. The agency enters into SAAs with various partners, such as MIT, for the purpose of advancing NASA mission and program objectives.

MOMENTUM 2023 Judges, Dr. Mahmooda Sultana (NASA Goddard), Dr. Aprille Ericsson (NASA Goddard), provide feedback to the teams. Photo Credit: MIT Office of Minority Education

Students in MOMENTUM 2023 were placed in one of 10 teams and were challenged to use an engineering approach to solve a problem related to a mission concept

Sultana is developing. With the assistance of Goddard engineers and scientists, they were challenged to explore methods to either decelerate a solar sail from transit speed upon arrival at Neptune or achieve attitude control with a lightweight and low-power solution. The teams were specifically asked to explore creative solutions to answer one of the following Challenge questions:

- Speed Challenge: How can we slow down a "Science Craft" (a solar sail with a 5-to10 grams per square meter areal density) upon reaching Neptune, either to make an orbiter or to increase the period of science observations in a flyby mission?

- Attitude Control Challenge: What is the best way to achieve attitude control using lightweight and low-power solutions?

To prepare for and then answer these questions during the four-week course – from January 9 through February 3 – students received virtual lectures, oral presentations, and design feedback with employees from Goddard and other NASA centers. The course culminated in group presentations to a panel of experts, which included Sultana and Goddard aerospace engineer Dr. Aprille Ericsson. Winning team members received gift cards from MIT. At the conclusion of the Challenge, many students expressed an interest in applying for NASA internships.

"MOMENTUEM 2023 was an excellent activity that expanded our brains in several dimensions," said Goddard Chief Technologist Michael Johnson, one of the members of the NASA team that participated on the Challenge. "The MIT students will remember the experience for a lifetime. Even better, some of them [may] end up working at NASA or advancing the U.S. space economy."

"I think MOMENTUEM 2023 was highly successful because the students learned a lot," recalled Sultana. "One of the students said the MOMENTUM challenge was the highlight of her time at MIT. Another student said, even though he was familiar with space missions before, this activity gave him a completely new perspective of what NASA does and a new appreciation for space missions."

While the MOMENTUM Challenge 2023 was fully funded by MIT, Goddard was able to participate in it through a project funded by NASA's Innovative Advanced Concepts (NIAC) Program. NIAC is designed to nurture visionary ideas that could transform the future of NASA missions by engaging innovators and entrepreneurs, such as MIT. "These NIAC studies help NASA determine whether these futuristic ideas could set the stage for future space exploration capabilities and enable amazing new missions," said Michael LaPointe, program executive for NIAC at NASA Headquarters.

One of the MOMENTUM 2023 teams shares their proposed solution to one of the NASA Goddard challenges, and summarizes their work.
Photo Credit: MIT Office of Minority Education

THE STRATEGIC PARTNERSHIPS OFFICE (SPO) PRESENTS

INNOVATOR HOUR

Have questions about protecting your innovation?
Want to learn more about how to submit New Technology Reports?
Have general questions about technology transfer and partnerships?
Sign up for a one-on-one 20-minute timeslot with a SPO representative.
Meetings will be held virtually via Microsoft Teams.

NEXT SESSION: **TUESDAY, MARCH 14, 2023**
1:00-2:00 P.M.

Available Timeslots
1:00-1:20 P.M.
1:20-1:40 P.M.
1:40-2:00 P.M.

How to Sign Up

To register for the upcoming session and secure your timeslot, complete the registration form.

Getting to Know You

Meet the Staff in Goddard's Strategic Partnerships Office

Marcus Payne, SBIR/STTR (Small Business Innovation Research/Small Business Technology Transfer) Project Support

Payne works directly with the science and engineering communities, both at Goddard and in the small business world. In this work, NASA funds are directed toward U.S. small businesses for research and development projects that benefit NASA and the broader economy.

Bio

Payne began working at NASA Goddard as an intern in 2018, the summer after completing an undergraduate business degree from the University of Montana Western. His 10-week internship was with Goddard's Strategic Partnerships Office (SPO), where he worked with the marketing team. After completing the internship, Marcus moved across the country, from Montana to Maryland, to join SPO's marketing team as a full-time contractor. In early 2020, he shifted from SPO's marketing team to the SBIR/STTR team, which is conveniently still under the umbrella of SPO.

What is one thing about SBIR/STTR everyone should know?

The goal of the SBIR/STTR Program is to give small businesses the opportunity to engage in federal research and development. The program allows Goddard scientists and engineers to "infuse" these technology developments into their research, missions, and flight projects. The greater NASA community identifies technology gaps the agency has and includes those in the program's annual solicitation. For selected proposals, the SBIR/STTR program provides early-stage funding to firms that can help fill NASA's technology gaps. It also offers matching funds through post-phase 2 opportunities to continue the development of new technologies through higher Technology Readiness Levels.

For questions about Goddard SBIR/STTR topics, you can contact Marcus Payne via email at marcus.r.payne@nasa.gov or by phone: 301-286-7609